Getty Mining Company | P. O. Box 838, Tooele, Utah 84074-0838 • Telephone (801) 268-4447

Mercur Mine



March 1, 1985

Mr. Ron Daniels
Division of Oil, Gas and Mining
355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203

Dear Mr. Daniels:

Subject: Proposed Amendment to ACT/045/013, Mercur Gold Mine

On March 10, 1981, Getty filed with the Division a Notice of Intention and a Mining and Reclamation Plan for the Mercur Gold Mine. This notice was approved, and a Mined Land Reclamation Contract was executed by the Board on October 13, 1981. This permit continues to be the prime DOGM authorization for this property.

On March 22, 1982, Getty submitted an amendment to its permit to accommodate various changes in size and layout of mining operations which became apparent following start-up. This amendment was approved by the Division, and the Board executed a new Reclamation Contract, which replaced the old contract, on April 28, 1983.

Now, in order to increase the production efficiency of this operation, Getty submits the enclosed information as a second amendment to its permit. This information describes the construction, operation and reclamation for a proposed dump leach facility located adjacent to Getty's existing operations. Through this action we request the Division's approval of this proposal as another amendment to the existing permit. We have enclosed our estimate as to the extent this proposal increases the total reclamation liability for the property. We expect that the reclamation commitments for other portions of our operations not affected by this proposal will remain the same.

Please respond with your comments on this matter to Mr. Glenn M. Eurick at this location.

Sincerely,

Robert H. Migliaccio

Robert H. Migliaccio
General Manager

Enclosure

cc: F. D. Wicks
G. M. Eurick

## 1.0 PROPOSED ACTION

### 1.1 General Description

Getty Mining Company is proposing to construct and operate a dump leaching system for extraction of gold from low grade ore at the Mercur Gold Mine. This operation would be in addition to Getty's present milling operations and is located adjacent to the existing mill. Low grade ore will be mined from the current open pit operation and trucked to the dump sites. The leachate collected from the leach dumps will be pumped to the existing mill circuit.

### 1.2 Phased Approach Layout

As shown on Drawing Nos. 1 and 2, construction of the leach dumps will be developed in two phases. The first phase will commence as soon as possible and will consist of developing leach dump no.1 in the drainage immediately north of the present mill pad. This dump will fill the drainage but will not impact on the existing paved access road. To provide haul truck access from the mine, a new haul road will be constructed to the south of the existing access road. Leaching of dump area #1 is scheduled to commence on 7-1-85. Construction of the initial dump area #2 will occur during mid - 1985 so it will be ready to leach on 8-1-85. Drawing No. 1 shows the anticipated configuration of the dump leaching operation at the end of 5 years. At this point in time, leach dump area #2 should be near completed and leach dump area #1 will be as large as possible without having to reroute the access road. Further expansion of this dump would occur following the rerouting of the access road as shown in Drawing No.2.

Drawing No.2 shows the leach dump layout at the end of 10 years of operation. The access road would be rerouted to the north of its present location and the pre-existing access road would be buried under leach dump #1. The maximum size of the total dump leach facility would be as follows:

| | |
|---|---|
| Leach Dump Area #1 | 40 acres |
| Leach Dump Area #2 | 21 acres |
| New Roads | 9 acres |

Drawings 1 and 2 depict an extended permit area boundary which add 125 acres. Within this area, 70 acres are planned for disturbance at this time.

### 1.3 Foundation Preparation

Construction of the dump foundation is illustrated in Drawing Nos. 3 and 4 and will proceed as follows:

Clear off all existing vegetation

Remove all topsoil and vegetation and place on topsoil stockpiles. Produce a uniformly sloping ground surface configuration by grading and filling as required.

Place and compact approximately 2 feet of low permeability tailings borrowed from the nearby Golden Gate or Sacramento Mill tailings pile.

Lay a nominal 30-mil synthetic sheet liner and extend it over 5 foot berms located at the toe of the proposed dump.

Place approximately 2 feet of Golden Gate or Sacramento Mill tailings material over the synthetic liner.

Install the leach solution collection system at the low point of the foundation.

Cover the leachate collection system with geotextile and 1 foot of permeable sand or tailings material.

## 1.4 Liner Design

The liner is designed to collect all leach solutions. The primary liner will be PVC, HDPE or similiar synthetic sheet placed in panels with solvent or thermally welded seams. This liner will be protected with a 2 foot cushion of tailings material to prevent punctures from the overlying ore. Additional leakage control will be provided by the low permeability tailings under the plastic liner. This material will be selectively borrowed from the low permeable material in the existing tailing piles and will be compacted to a greater density to minimize its permeability.

## 1.5 Dump Construction

The leach dumps will be constructed in nominal 15 foot high lifts of low-grade ore. Each lift will be leached separately until the gold extraction reaches acceptable levels. The surface of each leached lift will then be ripped with a bulldozer prior to placing the next lift.

## 1.6 Leaching Operation

A weak sodium cyanide/sodium hydroxide solution will be used as the leaching solution. It will be prepared from the active tailings pond reclaim water at the present mill reagent area and piped to the leach dumps. At the dump, the barren leach solution will be sprayed over the top of the dump with a network of distribution header and lateral pipes connected to spray heads (see Drawing No. 5). Spray heads and pipe pressures will be selected to minimize over-spray and evaporation of the leach solution.

The leach solution will percolate down through the dump to the liner system where the solution will migrate laterally to the collection pipe at the low point of the dump. The collection pipe will transport the pregnant solution to a lined sump at the lowest point of the dump. The pregnant solution will then be pumped from the sump via a cistern well and transported back to the mill in a pipeline. The leach dump pregnant solution will be added to the normal mill leaching circuit as dilution water.

The liner will be extended up the sides of the basins which contain the dumps to collect all leach solutions. The lowest points of the liners will be against embankments located at the toes of the dumps. The liners will be extended up the roads embankments as shown in Drawing No. 4 to heights calculated to contain all leach solutions and the infiltration from the 10 year-24 hour precipitation falling on the dumps. This will assure no escape of solutions in the event of an unexpected power failure to the pregnant solution collection pumps.

1.7 Dump Closure

After leaching in either dump has been permanently discontinued, a combination of fresh water and as needed, chlorine solution will be sprayed over the dump until cyanide levels in the solution collected from the base of the dump reach acceptable low levels. The solution distribution and collection plumbing will then be removed from the surface of the dump and reclamation will commence.

## 2.0 HYDROLOGY

### 2.1 Surface Hydrology

The objective of the surface hydrology design is to: minimize run-on to the dumps from adjacent areas and; reroute the drainage from disturbed areas (other than the leach dumps) through diversion and collection channels to existing sediment ponds.

Construction of the 5-year leach dump configuration requires removal of the existing sediment pond to the north of the plant site. This phase also required the diversion of runoff around leach dump areas #1 and #2 in new alignments as shown on Drawing No.1. The combined flow of these channels will be routed to the existing sediment pond B which at 11.2 acre-feet is large enough to contain the 10 year-24 hour runoff (1.6 acre-feet) without discharge.

The final 10 year configuration of the leach dump operation is shown in Drawing No.2. This configuration results in dump area #1 extending over the sediment pond B. The surface drainage system around dump area #1 is illustrated in Drawing 2. Drainage flowing past the plant site will be routed around the south and west side of the dump. Other runoff will be routed along the new access road. The combined flow of these ditches will be routed to the existing sediment ponds C1 and C2 located down-canyon of the leach dump area. These have a capacity of 10.7 acre-feet which will contain the 10 year-24 hour runoff (1.72 acre-feet).

All of the above channels will be triangular earth ditches with capacities equal to at least 110% of the anticipated 10 year 24 hour peak flows.

Precipitation falling on the leach dumps will be contained within the leaching circuit and will not be discharged to the environment.

## 2.2 Ground Water Hydrology

The proposed dump leach facilities are located over the upper Great Blue Limestone, a strongly fractured limestone unit with numerous thin clay partings.

This unit dips generally to the east at about 45 degrees. Outcropping to the west of the proposed facilities, and stratigraphically below the upper Great Blue Limestone is the Long Trail Shale, a black, calcareous shale unit about 150 feet thick. To the east of leach dump #2 and stratigraphically above the upper Great Blue Limestone is the Manning Canyon Shale. This formation consists primarily of shale with limestone and quartzite interbeds and ranges from 1,100 to 1,500 feet thick.

Groundwater under the proposed dump leach facilities is confined to the upper Great Blue Limestone between the Long Trail Shale and the Manning Canyon Shale. This groundwater moves down-dip toward Cedar Valley and is not known to be discharged either in springs or wells down gradient of Mercur. There is no record of attempt to develop this water in the Cedar Valley area as it is confined below the Manning Canyon Shale at a projected depth of 7,300 feet below the ground surface. Because the alluvial fill aquifer in Cedar Valley overlays the Manning Canyon Shale and provides an adequate water supply for the foreseeable future, the upper Great Blue Limestone is not expected to be a source of groundwater.

Little is known about the groundwater table in the vicinity of the proposed dump leach facilities. Exploratory drill holes in the upper Great Blue Limestone do not intercept significant amounts of groundwater which is contained in fractures within the limestone.

## 2.3 Spill Prevention

The proposed dump leach facilities have been designed with a foundation liner configuration which will contain all reagents within the base of the dumps. The lined 5 foot high berms at the toes of the dump slopes and the lined sump areas at the lowest points of the dump foundations will assure that all leaching solutions and precipitation which enters the dumps will be contained within the dumps themselves.

Reagents will be mixed with the barren leach solution at the existing mill reagent area. Pregnant dump leach solution will be received at the mill (Drawing No.5). Transportation of these solutions between the mill and the dumps will be via closed pipelines. Open solution ditches and ponds common to other cyanide heap leach operations will not exist at this dump leach eliminating the potential for spills of solutions. The mill facilities are presently equipped with spill control measures therefor additional spill control measures are not being proposed.

## 3.0 RECLAMATION

### 3.1 Preparation

Following the termination of leaching operations, all piping and equipment will be removed from the leach dumps. The topsoil which was stockpiled during construction of the dumps will then be salvaged and spread over the dump surfaces.

### 3.2 Topsoil Replacement

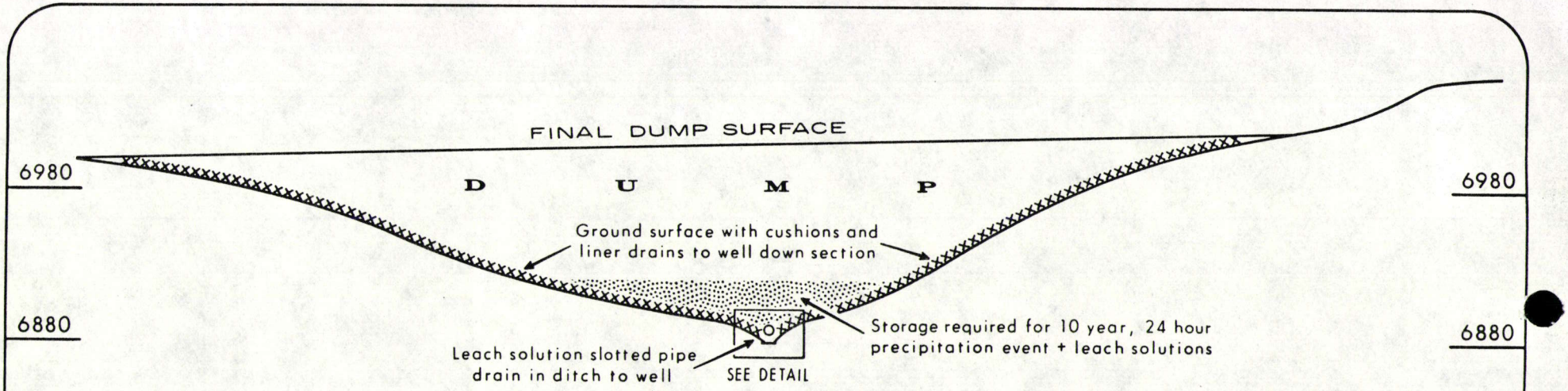
It is estimated that approximately 37,000 $yd^3$ of topsoil will be available for reclamation of the dumps and new roads described in this proposal. If spread uniformly over the disturbed surfaces, this volume of topsoil will provide about 4 inches of spread depth. On the flat surfaces, topsoil will be hauled and placed with scrapers. Topsoil for the dump slopes will be hauled from the stockpiles in trucks and placed over the slopes.

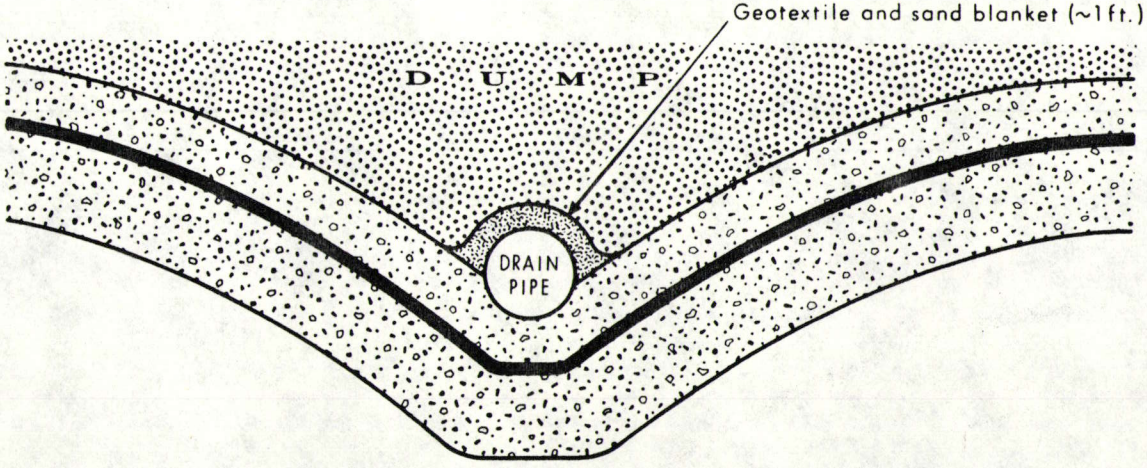
### 3.3 Road Access

The relocated plant site access road and the tailings line road south of leach dump area #2 will not be reclaimed. By agreement, ownership of these roads will be transfered to Tooele County at the conclusion of all operations for public use.

### 3.4 Revegetation

The revegetation plan proposed in Getty's Mining and Reclamation Plan of March, 1981 will be followed (see attached material). Reseeding and planting will commence immediately after topsoil is spread. The use of mulch is not anticipated but a cover crop may be seeded. Fertilizer will be applied as needed at the time of seeding.

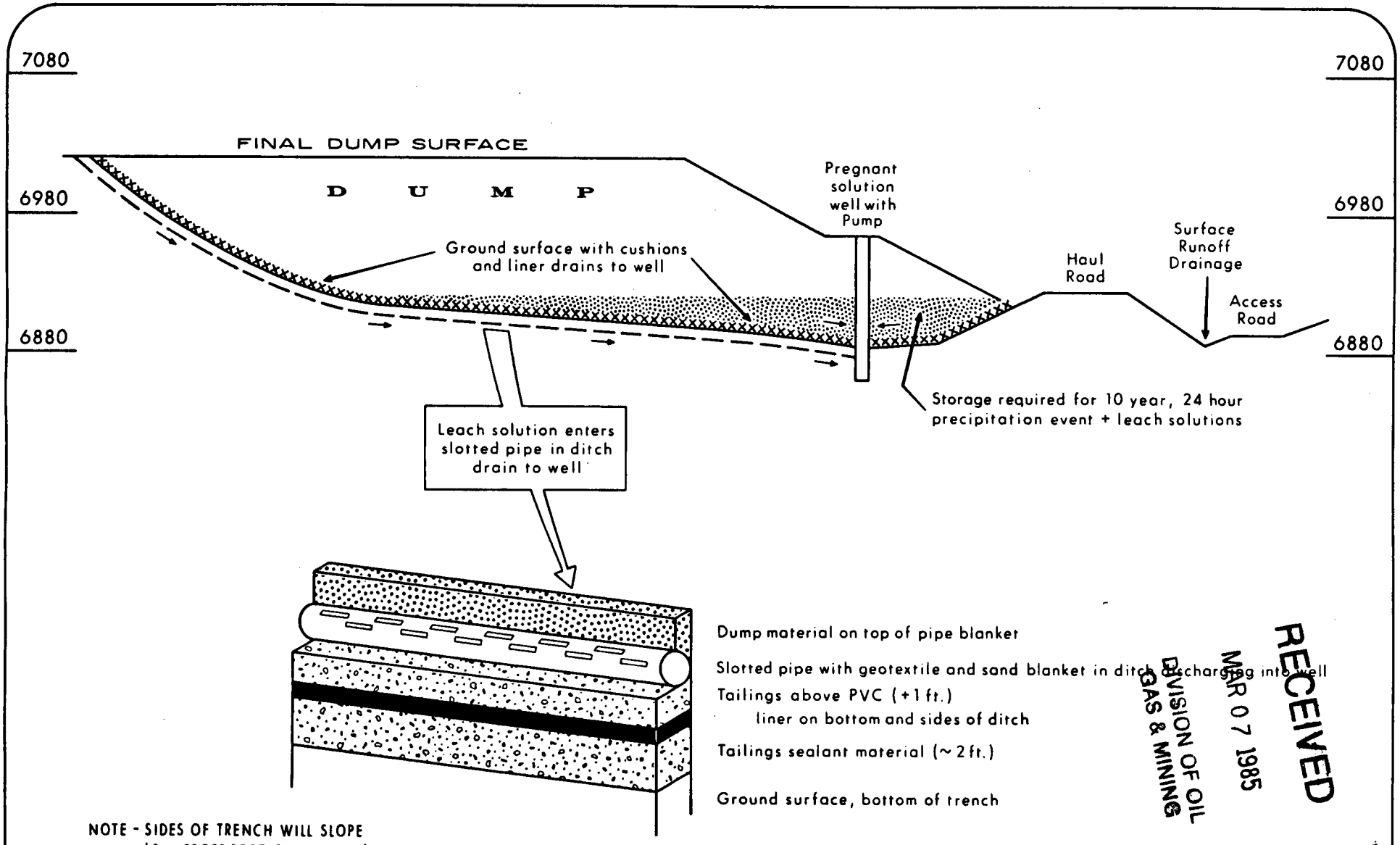



**MERCUR MINE**
DUMP LEACH PROJECT
Typical Cross Section
(No Scale)



DRAWING No. 3
G.M. Eurick 2/15/85




NOTE - SIDES OF TRENCH WILL SLOPE
(See CROSS SECTION EXHIBIT)

**MERCUR MINE**
DUMP LEACH PROJECT
Typical Longitudinal Section
(No Scale)

DRAWING No. 4
G.M. Eurick 2/15/85

RECEIVED
MAR 07 1985
DIVISION OF OIL
GAS & MINING

SECTION 2
SEED MIXES

## SEED MIX #1 RECLAMATION SPECIES FOR AREAS WITH TOPSOIL

| • Pure Live Seed | | DRILL LBS./ACRE |
|---|---|---|
| Agropyron dasystachyum | Thickspike Wheatgrass | 4 |
| Agropyron desertorum | Desert Wheatgrass | 1 |
| Agropyron riparium | Streambank Wheatgrass | 2 |
| Agropyron smithii | Western Wheatgrass | 2 |
| Agropyron spicatum var. inerme | Beardless Bluebunch Wheatgrass | 2 |
| Agropyron trachy caulum | Slender Wheatgrass | 2 |
| Agrostis alba | Redtop Bent | 1/4 |
| Bromus biebersteinii | Regar Brome | 1 |
| Bromu inermis | Smooth Brome | 1/2 |
| Elymus canadensis | Canada Wildrye | 1 |
| Elymus cinereus | Basin Wildrye | |
| Elymus junceus | Russian Wildrye | |
| Elymus triticoides | Creeping Wildrye | |
| Poa compressa | Canada Bluegrass | 1/4 |
| Stipa columbiana | Subalpine Needlegrass | 1 |
| Stipa lettermanii | Letterman Needlegrass | |
| Stipa viridula | Green Needlegrass | |
| Medicago sativa | Alfalfa Medic | 1 |
| Melilotus alba | White Sweetclover | |
| Meliotus officinalis | Yellow Sweetclover | 1/2 |
| | | 18 1/2 |

As calculated from Sharp Bros. Seed Company predicted p.l.s values, the above mix has a pure-liveness of 0.814;
18.5 lbs - 0.814 = 22.7 bulk lbs

| • Bulk Seed: | From Calculations Above | 22.7 |
|---|---|---|
| Atriplex canescens | Fourwing Saltbush | 1.3 |
| Atriplex confertifolia | Shadscale Saltbush | |
| Astragalus cicer | Cicer Milkvetch | |
| Carex spp. | Sedge species | |
| Dactylis glomerata | Common Orchardgrass | |
| Eleocharis spp. | Spikerush species | |
| Festuca ovina var. duriuscula | Hard Sheep Fescue | |
| Juncus spp. | Rush species | |
| Koeleria cristata | Prairie Junegrass | |
| Leucopoa (Hesperochloa) kingii | King Spikefescue | |
| Oryzopsis hymenoides | Indian Ricegrass | |
| Phleum pratense | Common Timothy | |
| Poa palustris | Fowl Bluegrass | |
| Poa pratensis | Kentucky Bluegrass | |
| Poa secunda | Sandberg Bluegrass | |
| Spartina gracilis | Alkali Cordgrass | |
| Sporobolus airoides | Alkali Sakaton | |
| Sporobolus cryptandrus | Sand Dropseed | |
| Commercial Forb Selection (seed mix list prior to tree & shrub lists) | | |
| | Bulk Total | 24 lbs |

APR 1 1985

NOTES:

a) Broadcast rate is double the drill rate.

b) Bracketed species will be used as they become commercially available. It is important to recongnze that the maximum number of species will be used for each seeding.

c) P.l.s. is the pure live seed content or percentage found in bulk seed. P.l.s is calculated by multiplying the germination rate times the purity rate. Example: A seed tag lists alfalfa as being 99% pure and having a 91% germination rate would have a pure live seed rate of 90% as seen by:

$$.99 \times .91 = .9009$$

A 5 lb/acre drill rate would be adjusted to a 5.6 lb/acre as seen by:

$$\frac{5}{.9009} = 5.6 \text{ adjusted lbs}$$

Because purity and germination rates vary with each growing season and from one seed producer to the next, the seed rates listed unless otherwise stated are p.l.s. rates.

d) Any species which are unavailable during any given seeding season will be replaced with additional amounts of Agropyron dasystachyum, Agropyron smithii, and/or Stipa viridula or the unavailable species will be deleted from the mix until the nex seeding season.

e) These seed mixes are proposed as general guidelines for actual practice. They may be revised due to site specific revegetation test plots and economic availability. The bracketed species will be selected from and are not intended to reflect the actual species diversity to be planted.

Site Variation Adaptability of SEED MIX #1*

| | |
|---|---|
| Dry Sites: | Agropyron, Elymus, Medicago, Melilotus |
| Moist Sites: | Agropyron smithii, Bromus inermis, Agrostis, Poa, Stipa |
| Warm Season: | Medicago, Melilotus |
| Cool Season: | All species listed |
| Silt Adapted: | Agropyron riparium, Agropyron smithii, Agrostis, Bromus, Elymus, Poa, Medicago, Melilotus, Stipa |
| Sand Adapted: | Agropyron dasystachyum, Agropyron trachycaulum, Elymus triticoides, Bromus, Medicago, Melilotus |
| Clay Adapted: | Agropyron, Bromus, Elymus, Stipa, Poa, Melilotus, Medicago |
| Rhizomatous Species | Agropyron dasystachyum, Agropyron riparium, Agropyron smithii, Agrostis alba, Elymus triticoides, Bromus inermis |

COMMENTS: Species such as Agropyron desertorium, Elymus, Bromus inermis, Stipa, and Agropyron trachycaulum will provide early spring greening. Agropyron spicatum var. inerme, Poa, and Agropyron trachycaulum have been included for their adaptability to shallow soils.

*The bulk seed species listed previously would also contribute members to each of the adaptability categories; however, the cover and frequency of the bulk species are of low significance as compared to total cover and frequency. Therefore, these species are not categorized.

SEED MIX #3 DIVERSION, STREAM CHANNEL, OR IMPOUNDMENT PERMANENT RECLAMATION
SPECIES FOR AREAS WITH OR WITHOUT TOPSOIL

- Pure Live Seed:

| | | DRILL LBS/ACRE |
|---|---|---|
| Agropyron dasystachyum | Thickspike Wheatgrass | 2 |
| Agropyron elongatum | Tall Wheatgrass | 1 |
| Agropyron riparium | Streambank Wheatgrass | 2 |
| Agropyron smithii | Western Wheatgrass | 4 |
| Agrostis alba | Redtop Bent | 1/2 |
| Bromus inermis | Smooth Brome | 1 |
| Bromus biebersteinii | Regar Brome | 1 |
| Dactylis glomerata | Common Orchardgrass | 1 |
| Elymus triticoides | Creeping Wildrye | 1 1/2 |
| Phleum pratense | Common Timothy | 1 |
| Poa compressa | Canada Bluegrass | 1/4 |
| Sporobolus airoides | Alkali Sakaton | 1/4 |
| Stipa viridula | Green Needlegrass | 1 |
| Astragalus cicer | Cicer Milkvetch | 2 |
| | | 18 1/2 |

As calculated from Sharp Bros. Seed Company predicted p.l.s values, the above mix has a pure-liveness of 0.790;
18.5 lbs ÷ 0.790 = 23.4 bulk lbs

- Bulk Seed: From Calculations Above 23.4

| | | |
|---|---|---|
| Trifolium hybridum | Alsike clover | |
| Festuca arundinacea | Tall Fescue | |
| Festuca ovina var. duriuscula | Hard Sheep Fescue | |
| Elymus canadensis | Canada Wildrye | |
| Oryzopsis hymenoides | Indian Ricegrass | |
| Eleocharis spp. | Spikerush species | |
| Juncus spp. | Rush species | |
| Koeleria cristata | Prairie Junegrass | |
| Poa palustris | Fowl Bluegrass | 1.6 |
| Poa pratensis | Kentudcky Bluegrass | |
| Poa secunda | Sandberg Bluegrass | |
| Spartina gracilis | Alkali Cordgrass | |
| Sporobolus cryptandrus | Sand Dropseed | |
| Puccinellia airoides | Nuttall Alkaligrass | |
| Distichlis spicata var. stricta | Inland Saltgrass | |
| Carex spp. | Sedge species | |
| Onobrychis viciaefolia | Common Sanfoin | |
| Typha latifolia | Common Cattail | |
| Commerical Forb selection (Seed mix prior to tree & shrub lists) | | |
| | Bulk Seed Total | 25 lbs |

NOTES:

a) Broadcast rate is double the drill rate (Establishment of Diverse Native Plant Communities on Coal Surface-Mined Lands in Montana as Influenced by Seeding Method, Mixture, and Rate by Edward J. DePuit, Joe G. Coenenberg, and Chester L. Skilbred, Montana State University 1980).

b) Bracketed species will be used as they become commercially available.

c) P.l.s. is the pure live seed content or percentage found in bulk seed. P.l.s is calculated by multiplying the germination rate times the purity rate. Example: A seed tag lists alfalfa as being 99% pure and having a 91% germination rate would have a pure live seed rate of 90% as seen by:

$$.99 \times .91 = .9009$$

A 5 lb/acre drill rate would be adjusted to a 5.6 lb/acre as seen by:

$$\frac{5}{.9009} = 5.6 \text{ adjusted lbs}$$

Because purity and germination rates vary with each growing season and from one seed producer to the next, the seed rates listed unless otherwise stated are p.l.s. rates.

d) Any species which are unavailable during any given seeding season will be replaced with additional amounts of Agropyron dasystachyum, Agropyron elongatum, Agropyron smithii, Sporobolus airoides, and/or Phleum pratense or the unavailable species will be deleted from the mix until the next seeding season.

e) These seed mixes are proposed as general guidelines for actual practice. They may be revised due to site specific revegetation test plots and economic availability. The bracketed species will be selected from and are not intended to reflect the actual species diversity to be planted.

Site Variation Adaptability of SEED MIX #3*

| | |
|---|---|
| Dry Sites: | Agropyron, Elymus, Sporobolus, Astragalus |
| Moist Sites: | All listed species |
| Warm Season: | Sporobolus, Astragalus, and any of the species receiving late spring to early summer runoff |
| Cool Season: | Agropyron, Bromus, Dactylis, Elymus, Phleum, Poa, Stipa, Astragalus |
| Silt Adapted: | Agropyron riparium, Agropyron smithii, Bromus, Elymus, Dactylis, Phleum, Poa, Sporobolus, Astragalus, Stipa |
| Sand Adapted: | Agropyron dasystachyum, Agropyron elongatum, Agropyron trachycaulum, Bromus, Dactylis, Elymus triticoides |
| Clay Adapted: | Agropyron, Bromus, Dactylis, Elymus, Phleum, Poa, Sporobolus, Stipa, Astragalus |
| Rhizomatous Species | Agropyron dasystachyum, Agropyron riparium, Agropyron smithii, Agrostis alba, Elymus triticoides, Bromus inermis |

COMMENTS: Species which provide early greening and soil holding have been maximized. Species such as Agropyron smithii, Elymus triticoides, Phleum pratense, Sporobolus airoides, and Agropyron elongatum are especially adapted not only to drought but to periodic inundation.

*The bulk seed species listed previously would also contribute members to each of the adaptability categories; however, the cover and frequency of the bulk species are of low significance as compared to total cover and frequency. Therefore, these species are not categorized.

SEED MIX #5 RECLAMATION SPECIES FOR RIGHTS-OF-WAY

- Pure Live Seed:

| | | DRILL LBS/ACRE |
|---|---|---|
| Agropyron dasystachyum | Thickspike Wheatgrass | 2 |
| Agropyron desertorum | Desert Wheatgrass | 1/2 |
| Agropyron elongatum | Tall Wheatgrass | 1/2 |
| Agropyron riparium | Streambank Wheatgrass | 1 |
| Agropyron spicatum var. inerme | Beardless Bluebunch Wheatgrass | 1 |
| Agropyron smithii | Western Wheatgrass | 4 |
| Agropyron trachycaulum | Slender Wheatgrass | 1 |
| Agrostis alba | Redtop Bent | 1/4 |
| Bromus biebersteinii | Regar Brome | 1/2 |
| Bromus inermis | Smooth Brome | 1/2 |
| Dactylis glomerata | Common Orchardgrass | 1/4 |
| Elymus canadensis | Canada Wildrye | 1/2 |
| Elymus cinereus | Basin Wildrye | |
| Elymus triticoides | Creeping Wildrye | |
| Oryzopsis hymenoides | Indian Ricegrass | 1/2 |
| Phleum pratense | Common Timothy | 1/4 |
| Poa compressa | Canada Bluegrass | 1/4 |
| Festuca arundinacea | Tall Fescue | 1/2 |
| Festuca ovina var. duriuscula | Hard Sheep Fescue | 1/2 |
| Sporobolus airoides | Alkali Sakaton | 1/4 |
| Sporobolus cryptandrus | Sand Dropseed | 1/4 |
| Medicago sativa | Alfalfa Medic | 1/2 |
| Melilotus alba | White Sweetclover | 1/2 |
| Melilotus officinalis | Yellow Sweetclover | |
| Astragalus cicer | Cicer Milkvetch | 1 |
| Atriplex canescens | Fourwing Saltbush | 1/2 |
| Stipa Columbiana | Subalpine Needlegrass | 1 1/2 |
| Stipa lettermanii | Letterman Needlegrass | |
| Stipa viridula | Green Needlegrass | |
| | | 18 1/2 |

As calculated from Sharp Bros. Seed Company predicted p.l.s values, the above mix has a pure-liveness of 0.765;
18.5 lbs ÷ 0.765 = 24.2 bulk lbs

NOTES:

a) Broadcast rate is double the drill rate (Establishment of Diverse Native Plant Communities on Coal Surface-Mined Lands in Montana as Influenced by Seeding Method, Mixture, and Rate by Edward J. DePuit, Joe G. Coenenberg, and Chester L. Skilbred, Montana State University 1980).

b) Bracketed species will be used as they become commercially available.

c) P.l.s. is the pure live seed content or percentage found in bulk seed. P.l.s is calculated by multiplying the germination rate times the purity rate. Example: A seed tag lists alfalfa as being 99% pure and having a 91% germination rate would have a pure live seed rate of 90% as seen by:

$$.99 \times .91 = .9009$$

A 5 lb/acre drill rate would be adjusted to a 5.6 lb/acre as seen by:

$$\frac{5}{.9009} = 5.6 \text{ adjusted lbs}$$

Because purity and germination rates vary with each growing season and from one seed producer to the next, the seed rates listed unless otherwise stated are p.l.s. rates.

d) Any species which are unavailable during any given seeding season will be replaced with additional amounts of Agropyron dasystachyum, Agropyron smithii, and/or Oryzopsis hymenoides, or the unavailable species will be deleted from the mix until the next seeding season.

e) These seed mixes are proposed as general quidelines for actual practice. They may be revised due to site specific revegetation test plots and economic availability. The bracketed species will be selected from and are not intended to reflect the actual species diversity to be planted.

Site Variation Adaptability of SEED MIX #5*

| | |
|---|---|
| Dry Sites: | Agropyron, Elymus, Sporobolus, Oryzopsis, Medicago, Astragalus, Melilotus, Atriplex, Stipa |
| Moist Sites: | Agropyron elongatum, Agrostis, Bromus, Agropyron smithii, Dactylis, Phleum, Poa, Festuca, Medicago, Melilotus |
| Warm Season: | Sporobolus, Medicago, Melilotus, Astragalus, Atriplex |
| Cool Season: | All species listed except for Sporobolus and the possible exception of Atriplex |
| Silt Adapted: | Agropyron riparium, Agropyron smithii, Agrostis, Bromus, Elymus, Dactylis, Oryzopsis, Phleum, Poa, Festuca, Sporobolus, Medicago, Astragalus, Melilotus, Atriplex, Stipa |
| Sand Adapted: | Agropyron elongatum, Agropyron dasystachyum, Agropyron trachycaulum, Bromus, Dactylis, Elymus triticoides, Sporobolus cryptandrus, Oryzopsis, Medicago, Melilotus, Atriplex |
| Clay Adapted: | Agropyron, Bromus, Dactylis, Elymus, Festuca, Phleum, Poa, Sporobolus, Medicago, Astragalus, Melilotus, Atriplex, Stipa |
| Rhizomatous Species | Agropyron dasystachyum, Agropyron riparium, Agropyron smithii, Bromus inermis, Elymus triticoides, Agrostis alba |

COMMENTS: Due to the high amount of site variation (i.e., cuts and fills) expected along rights-of-way, the number of species included in the mix was maximized. Palatable plant species were not avoided since domestic livestock does not greatly habitate the area. One possible deletion from the mix is melilotus (due to high growth form and potential fire hazard); if such deletion is desired, Agropyron smithii and Medicago sativa in a 50-50 ratio would ba a suitable replacement.

*The bulk seed species listed previously would also contribute members to each of the adaptability categories; however, the cover and frequency of the bulk species are of low significance as compared to total cover and frequency. Therefore, these species are not categorized.

SEED MIX #6 COVER CROP

| | | | BULK BROADCAST RATE LB/ACRE |
|---|---|---|---|
| Spring | Hordeum vulgare | Sixrow Barley | 50-60 |
| Fall | Triticum aestivum | Bread Wheat | 50-60 |

NOTE: For use only on areas where the slope is gently enought to allow farm equipment to disc in a cover crop.

COMMERCIAL FORB SELECTION

Seed Mixes #1, #2, and #3 include commercial forbs as part of the bulk seed mix.

| | |
|---|---|
| Achillea millefolium | Common Yarrow |
| Achillea lanulosa | Western Yarrow |
| Artemisa ludoviciana | Louisiana Sagewort |
| Balsamorhiza sagittata | Arrowleaf Balsamroot |
| Linum lewisii | Lewis Flax |
| Penstemon palmeri | Palmer Penstem |
| Penstemon venustus | Blue Mountains Penstem |
| Sphaeralcea munroana | Munro Globemallow |
| Thermopsis montana | Mountain Termopsis |
| Wyethia amplexicaulis | Mulesear Wyethia |
| Achillea borealis | Northern Yarrow |
| Aquilegia cerulea | Colorado Columbine |
| Arctostaphylos uva-ursi | Bearberry Manzanita |
| Arnica cordifolia | Heartleaf Arnica |
| Atriplex corrugata | Mat Saltbush |
| Centaurea cyanus | Cornflower Bachelor-button |
| Clarkia pulchella | Deerhorn Clarkia |
| Dodecathon spp. | Shootingstar species |
| Epilobium angustifolium | Fireweed Willowherb |
| Gaillardia aristata | Common Gaillardia |
| Gilia aggregata | Skyrocket Gilia |
| Helianthella uniflora | Oneflower Helianthella |
| Helianthus annuus | Common Sunflower |
| Iris missouriensis | Rockymountain Iris |
| Lonicera involucrata | Bearberry Honeysuckle |
| Lonicera utahensis | Utah Honeysuckle |
| Lupinus nootkatensis | Alaska Lupine |
| Mentzelia laevicaulis | Blazingstar Mentzelia |
| Oenothera hookeri | Hooker Eveningprimrose |
| Pedicularis groenlandica | Elephanthead Lousewort |
| Penstemon deustus | Scabland Penstem |
| Penstemon gracilis | Slender Penstem |
| Penstemon procerus | Littleflower Penstem |
| Penstemon triphyllus | Threeleaf Penstem |
| Penstemon strictus | Rockymountain Penstem |
| Philadelphus lewisii | Lewis Mockorange |
| Polygonum bistortoides | American Bistort |
| Prunus tomentosa | Nanking Cherry |
| Rosa gymnocarpa | Baldhip Rose |
| Rubus perviflorus | Western Thimbleberry |
| Smilacena racemosa | Wildspikenard False-solomonseal |
| Smilacena stellata | Starry Falsesolmonseal |
| Solidago occidentalis | Western Goldenrod |
| Vaccinium spp. | Whortleberry species |
| Wyethia helianthoides | Whitehead Wyethia |

COMMERCIAL FORB SELECTION (Continued)

| | |
|---|---|
| Alyssum saxalite | Basketofgold Alyssum |
| Anagallis arvensis | Sarlet Pimpernel |
| Aster chilensis | Pacific Aster |
| Aster tanacetifolius | Tansyleaf Aster |
| Baileya multiradiata | Desert Marigold |
| Chrysanthemum leucanthemum | Oxeyedaisy Chrysanthemum |
| Coreopsis lanceolata | Thickleaf Coreopsis |
| Delphinium ajacis | Rocket Larkspur |
| Dimorphotheca sinuata | Blueeyed Capemarigold |
| Penstemon cyananthus | Wasatch Penstem |
| Clematis ligusticifolia | Western Vriginsbower |
| Echinacea purpurea | Purple Echinacea |
| Erigonum umbellatum | Sulfur Wildbuckwheat |
| Eschscholtzia californica | California Goldpoppy |
| Gaillardia pulchella | Rosering Gaillardia |
| Geranium viscosissimum | Sticky Geranium |
| Gilia leptantha (chamissonis) | Blue Gilia |
| Gilia tricolor | Birdseye Gilia |
| Hedysarum boreale | Northern Sweetvetch |
| Lathyrus latifolius | Perrennial Peavine |
| Layia platyglossa | Yellowdaisy Tidytips |
| Liatris spicata | Spike Gayfeather |
| Ligusticum porteri | Porters lovage |
| Linanthus grandiflorus | Mountain Flaxflower |
| Linum grandiflorum rubrum | Scarlet Flowering Flax |
| Lomatium nuttalli | Nuttall Lomatium |
| Lupinus alpestris | Mountain Lupine |
| Lupinus sericeus | Silty Lumpine |
| Mentzelia lindleyi | Lindley Mentzelia |
| Nemophilia maculata | Spotted Nemophilia |
| Nemophilia menzeisii | Babyblueyes Nemophilia |
| Oenothera lamarckiana | Lamrck Eveningprimrose |
| Oenothera missouriensis | Ozark Sundrops |
| Oenothera pallida | Pale Eveningprimerose |
| Osmorhiza occidentalis | Anise Sweetroot |
| Papver nudicaule | Iceland Poppy |
| Papver rhoeas | Corn Poppy |
| Phacelia campanularia | Harebell Phacelia |
| Ratibida columaris | Upright Prairieconeflower |
| Rudbeckia hirta | Blackeyed Coneflower |
| Sanguisorba minor | Small Burnet |
| Saponaria officinalis | Bouncingbet Soapwort |
| Sphareralcea grossulariaefolia | Gooseberry Globemallow |
| Viguiera multiflora | Showy Goldeneye |
| Petalostemum candidum | White Prairieclover |
| Petalostemum purpureum | Purple Prairieclover |
| Amorpha canescens | Leadplant Amorpha |

| | |
|---|---|
| Arnica cordifolia | Heartleaf Arnica |
| Artemisia ludoviciana | Louisiana Sagewort |
| Aruncus sylvesterus | Sylvan Goastbeard |
| Balsamorrhiza hookeri | Hooker Balsamroot |
| Calochortus nuttalli | Sego Mariposalily |
| Carex geyeri | Elk Sedge |
| Cercis canadensis | Eastern Redbud |
| Clintonia uniflora | Queencup Cornlily |
| Lonicera ciliosa | Westerntrumpet Honeysuckle |
| Helianthus maximiliana | Maximilian Sunflower |
| Mimulus nanus | Dwarf Monkeyflower |
| Penstemon alpinus | Alpine Penstem |
| Phlox longifolia | Longleaf Phlox |
| Rubus leucodermis | Whitebark Raspberry |
| Senecio intergerrimum | Threadleaf Groundsel |

SECTION 3
TREE AND SHRUB PLANTING LISTS

TREE AND SHRUB PLANTING LIST #1

Species which are commercially available have been listed. Approximately 150 to 300 plants per acre will be fall planted on any areas where Seed Mix #1 is employed. The species will be planted in various sized clumps (5 to 15 individuals per clump) to assure 1) greater protection from wildlife during early establishment, and 2) cover for wildlife when fully established. Containerized stock is recommended over bare root stock. The numbers listed for any single species represent the maximum per acre planted of that kind. At least five varieties per acre will be planted.

| | | PLANT/ACRE |
|---|---|---|
| Amelanchier alnifolia | Saskatoon Serviceberry | 50 |
| Artemisia frigida | Fringed Sagewort | 50 |
| Artemisia ludoviciana | Louisiana Sagewort | 100 |
| Artemisia abrotanum | Oldman Wormwood | 50 |
| Artemisia tridentata var. wyomingensis | Wyoming Big Sagebrush | 25 |
| Atriplex canescens | Fourwing Sgebrush | 100 |
| Atriplex gardneri | Gardner Saltbush | 100 |
| Ceanothus velutinus | Snowbrush Ceanothus | 25 |
| Cercocarpus ledifolius | Curlleaf Mountainmahogany | 100 |
| Chrysothamnus nauseosus | Rubber RAbbitbrush | 150 |
| Cowania mexicana | Mexican Cliffrose | 25 |
| Elaeagnus angustifolia | Russianolive | 25 |
| Elhedra viridis | Green Mormontea | 25 |
| Ephedra torreyana | Torrey Mormontea | 25 |
| Ephedra trifurca | Longleaf Mormontea | 25 |
| Eriogonum umbellatum | Sulfur Wildbuckwheat | 25 |
| Frageria vesca | Wild Stawberry | 25 |
| Juniperus monosperma | Oneseed Juniper | 25 |
| Juniperus scopulorum | Rockymountain Juniper | 25 |
| Juniperus osteosperma | Utah Juniper | 25 |
| Juniperus osteosperma | Utah Juniper | 25 |
| Linum lewisii | Lewis Flax | 50 |
| Lonicera alba | White Honeysuckle | 25 |
| Lonicera japonica | Halls Honeysuckle | 25 |
| Acer glabrum | Rockymountain Maple | 75 |
| Acer grandidentatum | Bigtooth Maple | 100 |
| Acer negundo | Boxelder Maple | 25 |
| Atriplex confertifolia | Shadscale Saltbush | 100 |
| Ceratoides lanata | Common Winterfat | 100 |
| Berberis repens | Oregon Grape | 25 |
| Physocarpus malvaceus | Mallow Ninebark | 25 |
| Pinus edulis | Pinon Pine | 25 |
| Populus tremuloides | Quaking Aspen | 50 |

TREE & SHRUB PLANTING LIST #1 (Continued)

| | | PLANT/ACRE |
|---|---|---|
| Potentilla fruiticosa | Shrubby Cinquefoil | 25 |
| Prunus besseyi | Bessey Cherry | 50 |
| Prunus virginiana | Common Chokecherry | 50 |
| Purshia tridentata | Antelope Bitterbrush | 25 |
| Quercus gambeli | Gambel Oak | 50 |
| Quercus turbinella | Shrub Liveoak | 50 |
| Rhus glabra | Smooth Sumac | 100 |
| Rhus trilobata | Skunkbush Sumac | 100 |
| Ribes aureum | Golden Currant | 75 |
| Ribes cereum | Wax Currant | 75 |
| Ribes hudsonianum | Hudsonbay Currant | 25 |
| Ribes inerme | Whiteskem Currant | 25 |
| Ribes lacustre | Prickley Currant | 25 |
| Rosa rugosa | Rugosa Rose | 100 |
| Rosa woodsii | Woods Rose | 150 |
| Salix exigua | Coyote Willow | 25 |
| Salix amygdaloides | Peachleaf Willow | 25 |
| Sorbus scopulina | Greenes Mountainash | 25 |
| Symphoricarpos occidentalis | Western Snowberry | 50 |
| Symphoricarpos oreophilus | Mountain Snowberry | 100 |
| Lycium halimifolium | Matrimonyvine Wolfberry | 15 |
| Caragana arborescens | Siberian Peashrub | 15 |
| Shepherdia argentea | Silver Buffaloberry | 25 |
| Shepherdia canadensis | Russet Buffaloberry | 25 |
| Amelanchier utahensis | Utah Serviceberry | 100 |
| Alnus tenuifolia | Thinleaf Alder | 15 |
| Artemisia cana | Silver Sagebrush | 10 |
| Artemisia nova | Black Sagebrush | 25 |
| Atriplex rosea | Tumbling Ovach | 25 |
| Cercocarpus intricatus | Littleleaf Mountainmahogany | 50 |
| Chrysothamnus viscidiflorus | Douglas Rabbitbrush | 50 |
| Grayia spinosa | Spiny Hopsage | 50 |
| Holodiscus dumosus | Bush Rockspirea | 25 |
| Peraphyllum ramosissum | Common Squawapple | 25 |
| Ribes setosum (missouriensi) | Missouri Gooseberry | 50 |
| Salix alba | White Willow | 25 |
| Sambucus canadensis | American Elder | 25 |
| Tetradymia canescens | Gray Horsebrush | 50 |
| Tetradymia galbrata | Littleleaf Horsebrush | 50 |
| Tetradymia spimosa | Cottonthorn Horsebrush | 50 |
| Populus alba | White Poplar | 25 |
| Populus angustifolia | Narrowleaf Poplar | 50 |
| Populus nigra | Black Poplar | 25 |

TREE AND SHRUB PLANTING LIST #3

Species which are commercially available have been listed. Approximately 300 to 600 plants/acre will be planted on the areas where Seed Mix #3 is seeded and which are not underlain by tailings. These speces will be planted in various sized clumps (5 to 30 individuals per clump) to assure 1) greater protection from wildlife during early establishment and 2) cover for wildlife when fully established. containerized stock is recommended over bare root stock. The numbers listed for any single speices represent the maximum per acre planted of that kind. At least five varieties per acre will be planted.

| | | PLANT/ACRE |
|---|---|---|
| Amelanchier alnifolia | Saskatoon Serviceberry | 50 |
| Artemisia ludoviciana | Louisiana Sagewort | 100 |
| Cernothus velutinus | Snowbrush Ceanothus | 25 |
| Cercocarpus leadifolius | Curlleaf Mountainmahogany | 100 |
| Frageria vesca | Wild Strawberry | 100 |
| Lonicera alba | White Honeysuckle | 50 |
| Lonicera japonica | Halls Honeysuckle | 50 |
| Acer glabrum | Rockymountain Maple | 25 |
| Acer gratididentatum | Bigtooth Maple | 25 |
| Acer negundo | Boxelder Maple | |
| Berberis repens | Oregon Graps | 25 |
| Physocarpus malvaceus | Mallow Ninebark | 25 |
| Prunus bessevi | Bessey Cherry | 50 |
| Prunus virginiana | Common Chokecherry | 75 |
| Purshia tridentata | Antelope Bitterbrush | 50 |
| Rhus glabra | Smooth Sumac | 50 |
| Rhus trilobata | Skunkbush Sumac | 50 |
| Ribes aureum | Golden Currant | 150 |
| Ribes cereum | Wax Currant | 150 |
| Ribes hudsonianum | Hudsonbay Currant | 50 |
| Ribes inerme | WHiteskem Currant | 50 |
| Ribes lacustre | Prickley Curant | 150 |
| Rosa rugosa | Rugosa Rose | 50 |
| Rosa woodsii | Woods Rose | 50 |
| Salix exigua | Coyote Willow | 100 |
| Salix amygadaloides | Peachleaf Willow | 100 |
| Sorbus scopuliana | Greenes Mountainash | 25 |
| Symphoricarpos occidentalis | Western SNowberry | 25 |
| Symphoricarpos oreophilus | Mountain Snowberry | 25 |
| Lycium halimifolium | Matrimonyvine Wolfberry | 45 |
| Shepherdia argentea | Silver Buffaloberry | 50 |
| Shepherdia canadensis | Russet Buffaloberry | 50 |
| Typha latifolia | Common Cattail | 50 |
| Betula occidentalis | Water Birch | 25 |
| Amerlancier utahensis | Utah Serviceberry | 100 |
| Alnus tenuifolia | Thinleaf Alder | 25 |

TREE & SHRUB PLANTING LIST #3 (Continued)

| | | PLANT/ACRE |
|---|---|---|
| *Artemisia cana* | Silver Sagebrush | 75 |
| *Artemisia filifolia* | Sand Sagebrush | 75 |
| *Cercocarpus intricatus* | Littleleaf Mountainmahogany | 75 |
| *Peraphyllum ramosissum* | Common Squawapple | 25 |
| *Ribes setosum (missouriensis)* | Missouri Gooseberry | 100 |
| *Salix alba* | White Willow | 50 |
| *Sambucus canadensis* | American Elder | 25 |
| *Populus alba* | White Poplar | 50 |
| *Populus angustifolia* | Narrowleaf Poplar | 100 |
| *Populus nigra* | Black Poplar | 50 |

SECTION 4
NATURAL RETURN OF PLANT SPECIES

Besides the plant species which are specifically planted and seeded, it is anticipated that a number of speices will naturally return. These plants will establish through 10 soil handling processes, 2) aerial pioneering, 3) animal transport, 4) hydraulic means, and 5) their own physiologic structures (e.g., stolons, rhizomes, etc.). Some of these species include:

| | |
|---|---|
| Agropyron dasystachyum | Thickspike Wheatgrass |
| Agropyron smithii | Western Wheatgrass |
| Agropyron spicatum | Bluebunch Wheatgrass |
| Agropyron trachycaulum | Slender Wheatgrass |
| Agrostis alba | Redtop Bent |
| Bromus inermis | Smooth Brome |
| Bromus marginatus | Mountain Brome |
| Elymus candensis | Canada Wildrye |
| Elymus cinereus | Basin Wildrye |
| Koeleria cristata | Prairie Junegrass |
| Oryzopsis hymenoides | Indian Ricegrass |
| Poa canbyi | Canby Bluegrass |
| Poa cusickii | Cusick Bluegrass |
| Poa fendleriana | Fendler Bluegrass |
| Poa asecida | Dandberg Bluegrass |
| Poa palustris | Fowl Bluegrass |
| Stipa lettermannii | Lettermann Needlegrass |
| Stipa columbiana | Subapline Needlegrass |
| Carex spp. | Sedge species |
| Juncus balticus | Baltic Rush |
| Juncus spp. | Rush speices |
| Eleocharis parishii | Parish Spikerush |
| Achillea millefolium | Common Yarrow |
| Arenaria spp. | Sandwort speices |
| Arnica longifolia | Longleaf Arnica |
| Artemisia ludoviciana | Louisiana Sagewort |
| Balsamorphiza sagittata | Arrowleaf Balsamroot |
| Calochortis nuttallii | Sego Mariposilily |
| Ceratoides lanata | Common Winterfat |
| Clematis orientalis | Oreintal Celmatis |
| Cryptantha spp. | Crypthantha species |
| Distichlis spicata var. stricta | Inland Saltgrass |
| Deschampsia caespitosa | Bluejoint Reedgrass |
| Phleum alpinum | Alpine Timothy |
| Festuca idahoensis | Idaho Fescue |
| Puccinellia airoides | Nuttall Alkaligrass |
| Oryzopsis exigua | Little Ricegrass |
| Erigeron spp. | Fleabane species |
| Erogonum spp. | Wildbuckwheat speices |
| Erysimum asperum | Plains Wallflower |
| Haplopappus spp. | Goldlenweed species |

NATURAL RETURN PLANT SPECIES LIST (Continued)

| | |
|---|---|
| Helianthella spp. | Helianthella species |
| Helinathus spp. | Sunflower speices |
| Hymenoxys spp. | Actinea speices |
| Lomatium dissectum | Fernleaf Lomatium |
| Cowania mexicana | Mexican Cliffrose |
| Gravia spinosa | Spiny Hopsage |
| Mentzelia albicaulis | Whitestem Mentzelia |
| Mentzelia laevicaulis | Blazingstar Mentzelia |
| Mentzelia fusiformis | Spindleroot Bluebells |
| Mimulus guttatus | Common Monkeyflower |
| Oenothera caespitosa | Tufted Eveningprimrose |
| Orthocarpus tolmiei | Tolmie Owlclover |
| Penstemon spp. | Penstem species |
| Petalostemum spp. | Prairieclover speices |
| Phlox spp. | Phlox speices |
| Ranunculus spp. | Buttercup speices |
| Senecio crassulus | Thickleaf Groundsel |
| Sphaeralcea grossulariaefolia | Gooseberry Blobemallow |
| Taraxacum officinale | Common Dandelion |
| Atriplex gardneri | Gardner Saltbush |
| Atriplex canescens | Fourwing Saltbush |
| Atriplex confertifolia | Shadscale Saltbush |
| Cercocarpus intricatus | Littleleaf Mountainmahogany |
| Cercocarpus ledifolius | Curlleaf Mountainmahogany |
| Cercocarpus montanus | True Mountainmahogany |
| Chrysothamnus nauseosus | Rubber Rabbitbrush |
| Chrysothamnus viscidiflorus | Douglas Rabbitbrush |
| Ephedra viridis | Green Mormontea |
| Holodiscus dumosus | Bush Rockspirea |
| Lycium halimifolium | Matrimonyvine Wolfberry |
| Peraphyllum ramosissum | Common Squawapple |
| Prunus virginiana | Common Chokecherry |
| Purshia tridentata | Antelope Bitterbrush |
| Quercus gambeli | Gambel Oak |
| Rhus trilobate | Skunkbush Sumac |
| Ribes aureum | Golden Currant |
| Ribes cereum | Wax Currant |
| Ribes inerme | Whitestem Currant |
| Ribes setosum | Currant species |
| Rosa woodsii | Woods Rose |
| Salix alba | White Willow |
| Salix exigua | Coyote Willow |
| Sambucus canadensis | American Elder |
| Sarcobatus vermiculatus | Black Greasewood |
| Symphoricarpos oreophilus | Mountain Snowberry |
| Tetradymia canescens | Gray Horsebrush |
| Tetradymia spinosa | Cottonthorn Horsebrush |
| Acer glabrum | Rockymountain Maple |

NATURAL RETURN PLANT SPECIES LIST (Continued)

| | |
|---|---|
| Acer grandidentatum | Bigtooth Maple |
| Acer negundo | Boxelder Maple |
| Juniperus osteosperma | Utah Juniper |
| Pinus edulis | Pinon Pine |
| Pinus monophylla | Singleleaf Pine |
| Populus alba | White Poplar |
| Populus angustifolia | Narrowleaf Poplar |
| Populus nigra | Black Poplar |
| Populus tremuloides | Quacking Aspen |
| Tamarix pentandra | Saltcedar Tamarix |